

## PREFACE

In May 2004 a conference on “Methods in Phonology” was held in Berkeley, California. Many of the chapters in this volume emerged from that conference, although other invited chapters have been added so as to represent a yet broader range of approaches to the discipline. The conference was held in honor of John J. Ohala, and the contents of this book reflect his influence on the empirical methods that shape phonological inquiry.

The book focuses on two central facets of experimental approaches to phonology. One focus is on the experimental methods which, in our view, are foundational to testing hypotheses concerning speakers’ and listeners’ knowledge of their native sound systems, the acquisition of those systems, and the laws that govern sound systems. Methods, of course, are not static in any empirical science. In recent years there has been increased use of experimental methods in phonology along with the rise of new experimental techniques, and we see several factors as responsible for this change. First, phonology is addressing increasingly diverse questions about the structure of grammars and the representation of sound patterns in the mind and brain, about the relation between phonetic and phonological constraints, about categorization of sensory data, sound change, socially and geographically indexed variation, and so on; thus, phonology needs to be multifaceted in its methods. Second, technologies relevant to phonological inquiry continue to evolve, as does the availability of large-scale linguistic corpora; new technologies and databases open up new opportunities, new questions, and new grounds on which to test hypotheses. Third, there is growing recognition that phonological inquiry should be embedded within a framework informed by the biological, social, and cognitive sciences; application of standardized experimental techniques from these disciplines allows us to account for phonological structure in ways that are both consistent with established knowledge in these fields and (arguably) better able to provide a unified account of language and speech. Fourth, a clear demonstration that we understand phonetic and phonological principles is the ability to model relevant behaviors and patterns; consequently, the use of articulatory synthesis, stochastic methods, learning algorithms, pattern recognition techniques, and neural networks are of increasing importance to phonological inquiry.

A second focus of the volume is on the phonological findings that emerge from the use of experimental techniques and their theoretical implications. This is not a “how to” volume on methods in phonology, but is rather a volume on the types of answers and insights into phonological structure and phonological knowledge provided by experimental approaches to phonology. The most convincing case for the usefulness of a particular methodology is to demonstrate that it can provide solid evidence bearing on specific issues, and can tease apart alternative hypotheses.

All chapters in the collection represent both of these facets of experimental approaches to phonology. For this reason, and because some chapters demonstrate that applying multiple methods to phonological questions provides particularly compelling answers, the book is organized in terms of major phonological issues: (1) explaining phonological universals; (2) understanding the phonetic factors that may give rise to phonological change; (3) maintaining, enhancing, and modeling phonological contrast; and (4) assessing phonological knowledge (such as knowledge of phonotactic well-formedness).

Specific contributions illustrate how a given technique or set of techniques is being applied to these core issues. Reviewed and illustrated are traditional field methods (Hyman), psycholinguistic methods (Derwing; Grønnum and Basbøll; Nootboom and Quené; M. Ohala), corpus-based methods (Kohler; Maddieson; Pycha, Inkelas, and Sprouse), aerodynamic and articulatory methods (Bonaventura and Fujimura; Busà; Demolin; Solé), acoustic-perceptual methods (Beddor, Brasher, and Narayan; Blevins; Roengpitya; Shin), and statistical and modeling methods (Engstrand, Frid, and Lindblom; Fujisaki, Gu, and Ohno; Johnson; Nearey and Assmann; Schwartz, Boë, and Abry; Vaissière).

Taken together, the contributions demonstrate that the application of well-established methods from other disciplines to phonology has created new theoretical perspectives that have changed, for many, the window through which we view phonology. In this regard, not only does the maturity of the discipline emerge, but also its thriving, dynamic nature. That is, we see among these authors and more generally within the field a remarkable willingness of researchers to take on new ways of asking what are often long-standing questions, and to recognize the new theoretical territory that has opened up.

The five chapters in Part I delineate various theoretical considerations and provide background concerning the application of methods from other sciences. J. Ohala examines the significance of methods in scientific research and in advancing phonological theories, and explores methods as a means of change within a discipline. Hyman's paper makes a case, using data from Thlantlang Lai tonology, for the continued importance of direct data elicitation from a consultant (along with deductive reasoning) in testing linguistic hypotheses, thus meriting status as a branch of experimental phonology. Johnson explores exemplar-based theories, illustrating how phonological generalizations can emerge from phonetically detailed speech exemplars and investigating in more detail key issues to be addressed when phonology is situated in a cognitive model of human memory. Concentrating on the issues of German word-final devoicing and  $f_0$  alignment with articulation, Kohler's chapter illustrates the advantages of a paradigm that studies phonology in its communicative context using large databases of connected natural speech. Vaissière's paper demonstrates how experimentation using articulatory synthesis can inform phonological inquiry by exploring the acoustic-perceptual contribution of language-specific articulatory maneuvers to the realization of phonological contrasts.

The contributions in Part II, “Phonological Universals”, are concerned with providing explanations for the similarities that hold across the sound systems of many of the world’s languages. Demolin presents aerodynamic evidence in support of the view that changes in fundamental frequency are controlled by the speaker whereas changes in subglottal pressure are due to low-level mechanical effects, and discusses the implications for phonological universals. Maddieson’s chapter illustrates the use of a large phonological database to test hypotheses about cross-language patterns; he shows that the hypothesis that phonological systems might tend toward equal complexity finds little support when tested against a database of over 600 languages. Applying modeling techniques to assess the forces constraining phonological systems, Schwartz, Boë, and Abry find evidence reflecting maximum auditory distance, focalization, and maximum use of distinctive features, which they integrate in the perceptuo-motor framework PACT.

The chapters by Beddor, Brasher, and Narayan and by Busà in Part III, “Phonetic variation and phonological change”, use experimental methods to illustrate the principle that sound changes due to universal phonetic and cognitive factors have their origins in synchronic variation. Beddor *et al.* examine methods of speech perception as applied to variation and change, focusing on coarticulatory variation and the perceptual factors that underlie loss of the source of coarticulation but retention of its effects. Language-specific variation in coarticulatory effects is explored by Busà in aerodynamic and articulatory terms, with selected sound patterns being attributed to variation in articulatory coordination. Blevins reviews the authority and imprint of experimental methods in phonology, underscoring the insights into sound change (and into the recurring synchronic sound patterns that result from phonetically motivated changes) provided by speech perception experimentation. Engstrand, Frid, and Lindblom also bring to bear perceptual evidence by identifying the perceptual preconditions for historical and ongoing changes involving rhotics, demonstrating that the acoustic signal may be ambiguous as to the articulatory configuration that produced it, possibly leading to articulatory reinterpretation. The final chapter of this section, by Grønnum and Basbøll, investigates the acoustic properties of Danish stød and uses a naturalistic database (radio recordings) to investigate ongoing changes—in this case, simplification of the morphological and phonological contexts in which stød occurs.

The chapters in Part IV, “Modeling, Maintaining, and Enhancing Phonological Contrast”, address how phonological contrasts or features can be modeled and how they are manifested in the phonetic domain. Bonaventura and Fujimura’s contribution uses articulatory techniques for investigating the influences of prosody on gestural strength, and assesses the results within the Converter/Distributor model of speech production. Fujisaki, Gu, and Ohno consider the role of modeling in relating the physical characteristics of speech to phonological structure, illustrating how  $f_0$  contours in tone languages are generated by the Command–Response model and offering a new phonological representation of tonal systems. Focusing on the

ability of listeners to categorize the vowels of their language, Nearey and Assmann illustrate and assess several statistical pattern-recognition methods for modeling listeners' responses to vowel stimuli, and overall demonstrate the power of the "sliding template" approach. The chapter by Roengpitya offers a quantified analysis of Thai tones and shows that their canonical shape is altered by processes such as end truncation and phase realignment when the tone-bearing unit is longer or shorter (e.g. due to stress) than the canonical duration. The chapter by Solé teases apart targeted and mechanical properties in the speech signal by varying temporal factors, proposing that phonetic dimensions which adjust to variations in speaking rate/stress/pitch accent (i.e. which show an interaction effect) are under the control of the speaker, whereas properties that do not are mechanical.

The chapters in Part V, "Phonotactic and phonological knowledge", demonstrate the use of psycholinguistic, phonetic, and corpora-based methods to test fundamental claims concerning speakers' and listeners' knowledge of phonological processes and representations. Nooteboom assesses the SLIP technique as a window to speech planning, error detection and self-repairs, proposes improvements in the analysis of spoonerisms elicited with this technique, and draws relevant implications for theories of self-monitoring. A variety of psycholinguistic methods are used by Derwing and M. Ohala to determine the phonological status of selected linguistic units. Derwing, reporting on a series of experiments testing for the psychological reality of the onset-plus-rime theory of the syllable, finds support for this notion for English but not for Korean and Minnan, which seem to have a body-plus-coda structure. M. Ohala tests phonetic and phonological issues regarding Hindi geminates, including their durational status vis-à-vis singletons, clusters, and "apparent geminates" (i.e. assimilated consonant sequences), long-distance effects of geminates, and geminate syllabification. Pycha, Inkelas, and Sprouse assess the statistical and phonological bases for exceptional morphophonemic patterning in Turkish, using large-scale electronic corpora, and conclude that a phonological analysis in which the underlying representation of each root contains the information needed to derive the alternating forms offers the more insightful account. Shin's study of perception of assimilated sequences in Korean examines whether listeners have implicit knowledge of assimilatory processes, and evaluates current theoretical proposals in light of evidence suggestive of compensation for assimilation.

The use of experimental methods in phonology has created a research environment in which rigorous argumentation often depends on integrating data from an array of traditionally distinct disciplines. The work of John Ohala is a fine example of this. His own broad perspective on experimental phonology, which he views as an approach to phonology that might involve any number of methods but is characterized by the experimentalist's chief concern with "taking as much care as possible to refine one's beliefs" (Ohala and Jaeger 1986: 3), has had a defining influence on the study of the relation between phonetics and phonology and has helped set the stage for the present volume. John Ohala has encouraged generations of researchers to be

imaginative, to look to other disciplines for methods that enrich the study of phonology, and to test hypotheses against evidence from novel, non-traditional sources. We hope that the present volume will serve as a stimulus to promote further forays into experimental approaches to phonology.

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